

**Drainage Manual Rewrite  
Working Table of Contents  
July 20, 2010**

This document is a working table of contents for the new drainage manual. The table of contents will be updated as new chapters are released and/or modified.

This table of contents will also serve as a tracking document so that users can be aware of releases and modifications to the new drainage manual.

The new drainage manual is organized into Chapters (example, DR 200); each chapter is further subdivided into subjects (example, DR 201); subjects are further divided into sections (example, DR 201-1). When changes are required to chapters that have been newly released as a final draft, the manual will be revised on a subject by subject basis. These changes are summarized on the last page of this document.

A date is located on the left side of the footer on each page of the new manual. This will be the primary tracking element for the new manual. You will notice that each chapter listed in the table of contents has a final draft date associated with it. Each individual subject in the table of contents has a date listed as well. These individual subject dates, as listed in the working table of contents, will be the most current draft date for that particular subject. If a subject has not been updated since the release of the final draft for its chapter, then the subject date and chapter date will match. If a subject has been updated since the final draft was released, it will be reflected in the individual subject dates listed in the table contents and on each page of the newly updated subject.

If a chapter has not had its final draft released, the existing 1993 manual is the governing policy for that chapter.

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**100 Introduction (Not Drafted)**

## **200 Stormwater & Floodplain Management (Final Draft Date July 2009)**

- 201 General (07/09)
  - 201-1 Introduction
  - 201-2 Flood Hazards
  - 201-3 Interagency Coordination
  - 201-4 Legal Aspects
  - 201-5 Permits
- 202 Stormwater Management (07/09)
  - 202-1 Planning
  - 202-2 Water Quality Issues
  - 202-3 Water Quantity Issues
  - 202-4 General Goals of Drainage Facility Designs
  - 202-5 Stormwater Disposal
  - 202-6 Construction Considerations
  - 202-7 Maintenance Considerations
  - 202-8 Environmental Considerations
  - 202-9 NPDES
  - 202-10 Municipally Separate Storm Sewer System (MS4)
  - 202-11 Post Construction Best Management Practice (BMP)
  - 202-12 Vegetated Channels
  - 202-13 Drainage to Significant Resources
  - 202-14 Karst Considerations
    - Water Quality BMP's
    - Matching Proposed And Existing Hydrologic Conditions
    - Potential Flood Hazard
    - Stabilizations
  - 202-15 Wetlands
  - 202-16 Outlet Capacity
  - 202-17 Detention / Retention Storage
- 203 National Flood Insurance Program (07/09)
  - 203-1 General
  - 203-2 Flood Insurance
  - 203-3 Flood Disaster Protection
  - 203-4 Local Community
  - 203-5 NFIP Maps
  - 203-6 Executive Order 11988
  - 203-7 FHWA - FEMA Memorandum Of Understanding
  - 203-8 Kentucky Laws
- 204 KYTC Floodplain Management Policy (03/10)<sup>1</sup>
  - 204-1 General
  - 204-2 Encroachment Concept
  - 204-3 Environmental Process
  - 204-4 Applicability
  - 204-5 Risk Assessment

204-6	Local Floodplain Coordinators
204-7	Coordination Required for All Encroachments
204-8	Allowable Increase (Rise)
204-9	Encroachments Into Floodplains Without Detailed Studies
204-10	Encroachments Into Floodplains With Detailed Studies
204-11	No Rise (No Impact) Floodway Encroachment
204-12	Coordination With FEMA
204-13	Map Revisions <ul style="list-style-type: none"> <li>• CLOMR &amp; LOMR</li> <li>• Physical Map revisions</li> </ul>
204-14	Revisions Of Floodways That Are Consistent With NFIP Standards
204-15	Revisions Of Floodway That Are Not Consistent With NFIP Standards
204-16	KYTC Floodplain Management Flowcharts

#### Exhibits

200-1	Floodplain Policy Flowchart (07/09)
200-2	FEMA No Rise Procedure (03/10) <sup>2</sup>

**300    Drainage Folders (Not Drafted)**

## **400 Hydrology (Final Draft Date July 2010)**

- 401 Fundamentals
  - 401-1 General Information
  - 401-2 Hydrology
  - 401-3 Surface Runoff
  - 401-4 Peak Flow vs Hydrograph
  - 401-5 Peak Flow Methods
  - 401-6 Hydrograph Methods
  - 401-7 Karst Consideration
  - 401-8 Flood Insurance Studies
  - 401-9 Local Methods
  - 401-10 Fully Developed Watershed Conditions
  - 401-11 Precipitation Frequency Data
- 402 Return Interval
  - 402-1 General Information
  - 402-2 Application
- 403 Rational Method
  - 403-1 Introduction
  - 403-2 Rational Method Assumptions
  - 403-3 Runoff Coefficient (C)
  - 403-4 Time of Concentration (Tc)
    - Overland Flow Travel Time
    - Shallow Concentrated Flow Time
    - Channel and Pipe Travel Time
  - 403-5 Storm Intensity (I)
- 404 Regional Method
  - 404-1 Introduction
  - 404-2 Site Located At a Gaging Station
  - 404-3 Site Located On a Regulated Stream
  - 404-4 Rural Regression Equations
  - 404-5 Sites Near a Gage Station
  - 404-6 Nationwide Urban Regression Equations
  - 404-7 Jefferson County Regression Equations
  - 404-8 Watersheds Spanning Multiple Regions
- 405 NRCS Unit Hydrograph Method
  - 405-1 Introduction
  - 405-2 Rainfall
  - 405-3 Hydrologic Soil Groups
  - 405-4 Curve Number
  - 405-5 Rainfall-Runoff Relationship
  - 405-6 NRCS Dimensionless Unit Hydrograph
  - 405-7 Watershed Lag & Time of Concentration
  - 405-8 NRCS Unit Hydrograph Peak Discharge
  - 405-9 Convolution
  - 405-10 Application and Limitations

## **500 Open Channels (Final Draft Date February 2010)**

- 501 Introduction (02/10)
  - 501-1 Open Channel Flow
  - 501-2 General Design Considerations
  - 501-3 Roadside Ditches
  - 501-4 Stream Channels
- 502 Channel Classifications (02/10)
  - 502-1 Stream Channels
  - 502-2 Roadside Ditches
    - Normal Ditches
    - Special Ditches
    - Surface Ditches
    - Interceptor Ditches
  - 502-3 Roadside Ditch Geometry Considerations
  - 502-4 Bid Item Requirements for Roadside Ditches
  - 502-5 Plan Requirements for Roadside Ditches
- 503 Channel Hydraulics (02/10)
  - 503-1 Open Channel Flow Types
  - 503-2 Equation of Continuity
  - 503-3 Hydraulic Radius
  - 503-4 Energy
  - 503-5 Specific Energy
  - 503-6 Manning's Equation
  - 503-7 Manning's n & Relative Roughness
  - 503-8 Froude Number
  - 503-9 Depth of Flow
  - 503-10 Single Section Analysis
  - 503-11 Step-Backwater Analysis
    - Standard Step Method
    - Profile Calculations
- 504 Channel Linings (02/10)
  - 504-1 General
  - 504-2 Grass Lining
  - 504-3 Turf Reinforcing Mat
  - 504-4 Aggregate Lining
  - 504-5 Mattress Units (Gabion Baskets)
  - 504-6 Paved Lining
  - 504-7 Grouted & Partially Grouted Riprap

505	Channel Lining Hydraulics (02/10)
505-1	Applied Shear Stress
505-2	Manning's Roughness
	<ul style="list-style-type: none"> <li>• Grass Lining</li> <li>• Turf Reinforcing Mat</li> <li>• Aggregate Lining</li> <li>• Mattress Units</li> </ul>
505-3	Permissible Shear Stress
506	Stream Channel Considerations (02/10)
506-1	General
506-2	Natural Stream Types
506-3	Quantifying Stream Impacts
506-4	Stream Impact Thresholds
506-5	Channel Changes
506-6	Wetland Impacts
506-7	Avoidance of Stream & Wetland Impacts
506-8	Permitting and Other Environmental Consideration
507	Stream Morphology (02/10)
507-1	General
	<ul style="list-style-type: none"> <li>• Historic Aerial Photography</li> </ul>
507-2	Levels of Assessment
507-3	Factors That Affect Stream Stability
507-4	Aggradation / Degradation
507-5	Stream Response to Change
507-6	Stream Stability Countermeasures
	<ul style="list-style-type: none"> <li>• Meander Migration</li> <li>• Channel Braiding</li> <li>• Degradation</li> <li>• Aggradation</li> </ul>
508	Channel Design Procedures (02/10)
508-1	Roadside Ditches
508-2	Stream Channels
509	Channel Design Criteria Summary (02/10)
509-1	Roadside Ditches
509-2	Stream Channels
	Exhibits
500-1	Manning's n for Class C Vegetation (02/10)
500-2	Manning's n for Class D Vegetation (02/10)
500-3	Permissible Shear Stresses (02/10)



## **600 Culverts & Headwalls (Final Draft Date January 2010)**

- 601 General (01/10)
  - 601-1 Introduction
  - 601-2 Hydraulic Structure Types
  - 601-3 Environmental and Permitting
  - 601-4 Large Drainage Structures
  - 601-5 Advanced Situation Folders
- 602 Pipe (01/10)
  - 602-1 General
    - Pipe Materials
    - Additional Protective Measures
  - 602-2 Bidding Classifications
    - Entrance Pipe
    - Culvert Pipe
    - Storm Sewer Pipe
  - 602-3 Bid Alternates
  - 602-4 Exceptions Bid Alternates
  - 602-5 Wall Thicknesses
- 603 Box Culverts (01/10)
  - 603-1 Precast Reinforced Concrete Box Culvert Sections
    - Wall Thicknesses
  - 603-2 Cast In Place Reinforced Concrete Box Culverts (RCBC)
  - 603-3 Economic Comparisons
- 604 Special Use Structures (01/10)
  - 604-1 Introduction
  - 604-2 Bottomless (3-Sided) Structures
    - Foundations
    - Bottomless Reinforced Concrete Structures
    - Special Design Procedure For Bottomless Reinforced Concrete Structures
  - 604-3 Contracting Considerations
  - 604-4 Other Special Use Structures
  - 604-5 Alternate Bidding
- 605 Culvert Hydraulics (01/10)
  - 605-1 Introduction
  - 605-2 Hydraulic Design Series Number 5, Revised 2005 (HDS 5)
  - 605-3 Headwater
  - 605-4 Roadway Overtopping
  - 605-5 Tailwater
  - 605-6 Types of Flow Control
  - 605-7 Inlet Control
    - Types of Inlet Control
    - Inlet Control Equations
  - 605-8 Outlet Control
  - 605-9 Inlet Edge Configurations

605-10	Performance Curves
605-11	Corrosion <ul style="list-style-type: none"> <li>• Runoff pH Conditions</li> <li>• Potential Adverse pH</li> <li>• Construction Requirements</li> </ul>
605-12	Abrasion <ul style="list-style-type: none"> <li>• Construction Requirements</li> </ul>
605-13	Water Surface Profile Analysis
605-14	Outlet Velocity
606	End Treatments & Headwalls (01/10)
606-1	Introduction
606-2	Projecting Ends
606-3	Mitered Ends
606-4	Headwalls
606-5	Safety Headwalls <ul style="list-style-type: none"> <li>• Sloped box outlet type 1</li> <li>• Sloped and flared box inlet - outlet</li> <li>• Sloped box inlet or outlet type 1</li> <li>• Slope box inlet or outlet type 2</li> <li>• Metal end sections type 1 and 2 (parallel structures)</li> <li>• Metal end sections type 3 and 4 (cross structures)</li> <li>• Sloped &amp; parallel headwalls</li> </ul>
606-6	Non Safety Headwalls <ul style="list-style-type: none"> <li>• Concrete Headwalls</li> <li>• 18" – 24" Double And Triple Pipe Culvert Headwalls</li> <li>• U Type Headwall</li> <li>• Sloped &amp; Flared (S &amp; F) Headwall</li> <li>• Pipe Culvert Headwall</li> <li>• Double &amp; Triple Pipe Culvert Headwalls</li> </ul>
606-7	Bid Items And Construction Specifications
607	Improved Inlets (01/10)
607-1	Introduction
607-2	Side Tapered Inlets
607-3	Slope Tapered Inlets
607-4	Control Sections
607-5	KYTC Standard Side Tapered Inlet
607-6	Design Guidance

608	Layout Considerations (01/10)
608-1	Location
608-2	Stream Channel Relocations
608-3	Safety
608-4	Culvert (Barrel) Skews
608-5	Headwall (Inlet) Skews
608-6	Cover Heights
608-7	Cast In Place Reinforced Concrete Box Culverts (RCBC)
608-8	Wing Wall Layouts
608-9	Drift and Debris Control
608-10	Foundations
609	Culvert Design Procedure (01/10)
610	Design Criteria (01/10)
610-1	Design Storm Allowable Headwater
610-2	Check Storm Allowable Headwater
	<ul style="list-style-type: none"> <li>• Culverts Subject to NFIP Requirements</li> <li>• Culverts Not Subject to NFIP Requirements</li> <li>• Culvert Replacements</li> </ul>
610-3	Site Specific Allowable Headwater
610-4	Size Limits
610-5	Cover Height Limits
	<ul style="list-style-type: none"> <li>• Flowable Fill for Low Cover Heights</li> </ul>
610-6	Bends
610-7	Outlet Velocity

## **700    Inlets & Storm Sewers (Final Draft Date July 2009)**

- 701    Introduction (07/09)
  - 701-1    Storm Sewer Definition
  - 701-2    Function & Design Process
  - 701-3    Junctions
  - 701-4    Sanitary Sewers
  - 701-5    Combined Sewers
  
- 702    Inlets (07/09)
  - 702-1    Inlet Classification
  - 702-2    Standard Inlets
  - 702-3    General Placement Guidelines
  - 702-4    Composite Gutter Sections
  - 702-5    Curb Box Inlets
  - 702-6    Drop Box Inlets
  - 702-7    Bridge Deck Inlets
  - 702-8    Slotted Drain Pipes
  - 702-9    Special Purpose Inlets
  - 702-10   MSE / Retaining Walls / Barrier Walls & Drainage Inlets
  
- 703    Manholes & Junctions (07/09)
  - 703-1    General
  - 703-2    Manholes
    - Manhole Type A
    - Manhole Type B
    - Manhole Type C
  - 703-3    Concrete Cones For Manholes
  - 703-4    Junction Boxes
    - General
    - Junction Box (Standard)
    - Junction Box Type B
  - 703-5    Frames & Lids
  - 703-6    Pipe Anchors
    - General
    - Intermediate Anchors
    - End Anchors
  
- 704    Inlet Hydraulics (07/09)
  - 704-1    Inlet Locations
  - 704-2    Calculating Discharge to Inlets
  - 704-3    Gutter Capacity & Allowable Spread
  - 704-4    Grate Inlets on Grade
    - Parallel Bar Grates
    - Grate Debris Handling Efficiencies
    - Interception Capacities
  - 704-5    Curb Inlets on Grade
    - Interception Capacity
    - Curb Inlet Efficiency

704-6	Slotted Drain Pipe
704-7	Curb Inlets In Sag or Sump Locations <ul style="list-style-type: none"> <li>• Interception Capacity for Curb-Opening Inlets Operating as Weirs</li> <li>• Interception Capacity for Curb-Opening Inlets Operation as Orifices</li> </ul>
704-8	Pavement Grate Inlets in Sags
704-9	Flanking Inlets
704-10	Combination Inlets
704-11	Median & Channel Inlets
705	Storm Sewer Pipe (07/09)
705-1	Storm Sewer Pipe Types
705-2	Specifying Pipe in Plan Sheets
705-3	pH Requirements
705-4	Pipe Roughness
705-5	Sanitary or Combined Sewer Pipe Types
705-6	Outside Pipe Dimensions and Pipe Chambers
706	Storm Sewer Hydraulics (07/09)
706-1	General <ul style="list-style-type: none"> <li>• Design And Check Storms</li> </ul>
706-2	Hydraulic Capacity
706-3	Partially Full Pipe Hydraulics
706-4	Sensitivity of Pipe Capacity Variables
706-5	Storm Sewer Open Channel Design Procedure
706-6	Pressure Flow Design
706-7	HGL / EGL Calculations
707	Inlet & Storm Sewer Design Criteria (07/09)
707-1	Allowable Spread for Pavement Inlets
707-2	Flanking Inlets
707-3	Inlets in Channels
707-4	Maximum Access Point Spacing
707-5	Physical Pipe Requirements
707-6	Physical Inlet, Junction & Manhole Requirements
707-7	Storm Sewer Hydraulics
Exhibits	
700-1	Physical Attributes of KYTC Grated Inlets (07/09)
700-2	Inlet In Sag (07/09)

## **800 Bridge Hydraulics (Final Draft Date March 2010)**

- 801 General (03/10)
  - 801-1 Definition
  - 801-2 Design Considerations
  - 801-3 Surveying
  - 801-4 Hydraulic Structure Types
- 802 Environmental & Permitting (03/10)
  - 802-1 Introduction
  - 802-2 Permitting Considerations
    - Army Corps of Engineers Permits
    - Division of Water – State Water Quality Certifications
    - U.S. Coast Guard Permits
  - 802-3 Project Design for Minimization
- 803 Bridge Hydraulics (03/10)
  - 803-1 Flow Classification
  - 803-2 Hydraulic Modeling (Water Surface Profile Modeling)
  - 803-3 Flow Types
  - 803-4 Overtopping Flow
  - 803-5 Flow Distribution & Auxiliary Openings
  - 803-6 Performance Curves
  - 803-7 Bridge Deck Drainage
  - 803-8 Bridge End Drainage
- 804 Scour (03/10)
  - 804-1 Introduction
  - 804-2 Scour Types
  - 804-3 Plan-Form Changes
  - 804-4 Long Term Profile Changes
  - 804-5 Clear Water and Live Bed Scour
  - 804-6 Contraction Scour
  - 804-7 Local Scour
    - Pier Scour
    - Abutment Scour
  - 804-8 Total Scour Analysis Methods
    - Method 1
    - Method 2
  - 804-9 Return Intervals
  - 804-10 Geotechnical Considerations
  - 804-11 Countermeasures
    - Piers
    - Abutments
- 805 Layout Considerations (03/10)
  - 805-1 General
  - 805-2 Bridge Foundations

805-3	Bridge Substructure Types
	<ul style="list-style-type: none"> <li>• Wall Abutments</li> <li>• Spill Through Abutments</li> <li>• Piers</li> </ul>
805-4	Bridge Superstructure Types
	<ul style="list-style-type: none"> <li>• Side By Side Box Beams</li> <li>• Spread Box Beams</li> <li>• Spread Concrete "I" Beams</li> <li>• Spread Steel "I" Beams</li> <li>• Slab Bridges</li> <li>• Other Superstructure Types</li> </ul>
805-5	Structure Depth Calculations
805-6	Bridge and Span Lengths
805-7	Other Bridge Layout Considerations
806	Design Procedures (03/10)
806-1	Bridge Design Procedure
806-2	Scour Assessment Procedure
807	Design Criteria (03/10)
807-1	Risk Assessment
807-2	Design Storm Allowable Headwater
807-3	Check Storm Allowable Headwater
	<ul style="list-style-type: none"> <li>• Bridges Subject to NFIP Requirements</li> <li>• Bridges Not Subject to NFIP Requirements</li> <li>• Bridge Replacements</li> </ul>
807-4	Site Specific Allowable Headwater Elevations
807-5	Flow Distribution
807-6	Scour

#### Exhibits

800-1	Risk Assessment Form (03/10)
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**900 Dams & Storage (Final Draft Date July 2009)**

- 901 Fundamentals (07/09)
  - 901-1 Storage Considerations
  - 901-2 Hydrographs and Routing
  - 901-3 Culvert Sizing
  - 901-4 Dams
  - 901-5 Detention / Retention Basins
- 902 Detention / Retention Basins (07/09)
  - 902-1 Local Criteria
  - 902-2 Design Storm
  - 902-3 Inflow Hydrograph
  - 902-4 Basin Outlet
    - Principal Spillway
    - Hydraulic Control Structure
    - Emergency Spillway
    - Single Spillway Basins
    - Grates and Trash Racks
    - Outlet Protection
  - 902-5 Basin Volume
    - Underground Storage
  - 902-6 Basin Routing
  - 902-7 Seepage
  - 902-8 Construction Requirements
    - Berms
    - Spillway Pipes Through Berms
  - 902-9 Maintenance Considerations
  - 902-10 Design Procedure
  - 902-11 Design Criteria

Exhibits

- 900-1 Detention Basin Schematic (07/09)



## **1000 Erosion Control (Drafted, Final Draft Not Released)**

- 1001 Summary
  - 1001-1 General Information
  - 1001-2 Kentucky Pollutant Discharge Elimination System (KPDES)
- 1002 Erosion Minimization
  - 1002-1 Ground Cover
  - 1002-2 Channel Lining
  - 1002-3 Erodible Slopes
- 1003 Sediment Control
  - 1003-1 General Information
  - 1003-2 Silt Trap
  - 1003-3 Sedimentation Basins
  - 1003-4 Temporary Silt Fence
  - 1003-5 Temporary Silt Ditch
  - 1003-6 Temporary Drainageways
  - 1003-7 Permanent Ditches
- 1004 Erosion Control Plan Development
  - 1004-1 General Information
  - 1004-2 Construction Phasing
  - 1004-3 Plan Generation
  - 1004-4 Plan Details
- 1005 Energy Dissipation
  - 1005-1 General Information
  - 1005-2 Riprap-Lined Basin
  - 1005-3 Riprap-Lined Outlet Transition
  - 1005-4 Saint Anthony Falls (SAF) Basin
- 1006 Universal Soil Loss Equation
  - 1006-1 General Information

**1100 Miscellaneous (See Below)**

- 1101 Temporary Drainage Facilities (Final Draft Date July 2010)
  - 1101-1 Introduction
  - 1101-2 Selection Factors
  - 1101-3 Design Storm Return Interval
  - 1101-4 Example Application
- 1102 Computer Applications (See 1993 Manual Chapter 12)
- 1103 Plan Requirements (See 1993 Manual Chapter 2)
- 1104 Field Data Collection (See 1993 Manual Chapter 2)

## **Changes Made Since Initial Release**

Changes made after new chapters have been released are summarized below. Individual subjects listed in the table of contents will have a superscripted number listed after their date if that particular subject has been modified since the release of the final draft for that chapter. The number corresponds to the notes below that summarize that particular change.

1. Section 204-5 was updated to clarify some of the information pertaining to the risk assessment and to refer to a more detailed narrative that was added to DR 807
2. The Risk Assessment Form (formerly Exhibit 200-2 was moved to Bridges Exhibit 800-1. The FEMA No Rise Procedure was moved from Exhibit 200-3 to Exhibit 200-2.